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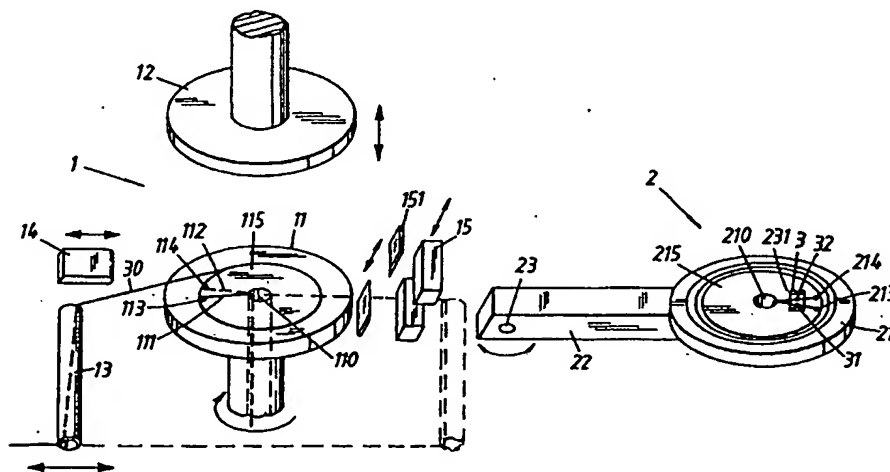
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| <p>(21) International Application Number: PCT/SE96/01447<br/>(22) International Filing Date: 11 November 1996 (11.11.96)<br/>(71) Applicant (for all designated States except US): METGET AB [SE/SE]; Metallgatan 1, S-372 38 Ronneby (SE).<br/>(72) Inventor; and<br/>(75) Inventor/Applicant (for US only): WARGREN, Bengt [SE/SE]; Linnégatan 98, S-115 26 Stockholm (SE).<br/>(74) Agents: NILSSON, Karl et al.; Stenhagen Patentbyrå AB, P.O. Box 4630, S-116 91 Stockholm (SE).</p> |                  | <p>(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published<br/>With international search report.</p> |

(54) Title: A COIL MANUFACTURING AND ATTACHMENT METHOD AND APPARATUS FOR CARRYING OUT THE METHOD



(57) Abstract

A method of manufacturing a coil and attaching the coil to contact points of an electric circuit comprises the steps of bringing one end of a winding filament (30) in a stretched state to a first position (111) in a winding machine (1); winding the filament (30) to provide a coil; and bringing the winding filament (30) after the coil in a stretched state to a second position (112) in the winding machine (1) and thereafter cutting the filament. According to the invention, the predetermined positions (111, 112) are placed inwardly of the coil and a circuit fixture (2) carrying an electric circuit (3) at a third position (231) corresponding to the first position (111) and the second position (112) inwardly of the coil is caused to collect the wound coil, and the filament ends of the coil are welded together at the contact points (31, 32) on the circuit (3) inwardly of the coil. The ends of the winding filament (30) are held firmly at the first position (111) and the second position (112) respectively by means of a hole (110) with subpressure in the winding machine (1), and at the third position (231) by means of a hole (210) with subpressure in the circuit fixture (2).

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A COIL MANUFACTURING AND ATTACHMENT METHOD AND APPARATUS FOR  
CARRYING OUT THE METHOD

FIELD OF INVENTION

5 The present invention relates to a method of manufacturing a coil and attaching the thus manufactured coil to the contact points of an electric circuit. The invention also relates to apparatus for carrying out the method.

10 More specifically, the invention relates to the manufacture of electric components of very small dimensions, and in particular components that include a coil which is connected to one or more electronic circuits or to one or more chips or integrated  
15 circuits, printed circuits or like electronic elements. Reference to electric circuits in the following will be understood to include one or more kinds of the aforesaid elements on each mentioning occasion.

20 DESCRIPTION OF THE BACKGROUND ART

Certain problems arise in the manufacture of components of the  
aforedescribed nature. These problems are essentially caused by  
the very small dimensions of the elements concerned and require  
25 manufacturing precision. Typical dimensions of electronic circuits of the kind in question are in the order of 0.9 x 0.9 x 0.4 mm and such a circuit will typically weigh 4 mg. The copper filament used in winding the coil has a typical diameter  
of 0.03 mm including insulation.

30 In manufacturing such a component, it has earlier been necessary to pre-attach, e.g., a chip to a tool and then wind a coil with the aid of a so-called flyer with one end of the copper filament affixed to a contact point on the chip, and  
35 thereafter affix the other end of the copper filament across the next contact point and therewith establish contact across the whole of the circuit, upon completion of the coil winding

process. One such method of procedure is described in European Patent Specification 0573469.

5 A coil that has been manufactured in this traditional manner will have a very non-uniform quality, because the filament, or wire, is taken from an external source and placed adjacent the bobbin centre, which initially has a given shape (thickness), and is wound initially from within and outwards. Consequently, fewer layers of copper filament are obtained where the first  
10 end of the filament has passed in towards the centre of the coil and winding has commenced. As a result, the coil will be wider in this region in order to obtain the same number of turns. The corresponding side of the coil then receives more layers and will thus be thicker.

15 An object of the present invention is to make possible the manufacture of a coil of greater and more uniform quality, by coiling the filament instead of winding the filament with the aid of a flyer, whereby the electronic circuit or circuits  
20 is/are kept outside the actual coiling procedure. This more uniform quality is achieved by placing the filament in the centre from the very beginning and then coiling the filament outwards in the tool.

25 Another object of the invention is to place the chip, etc., in the coil centre hole directly, thereby avoiding the need to fold-in the chip manually.

30 A further object of the invention is to enable copper filament and chip to be held in place with the aid of sub-pressure, which has been found to be a much simpler and much cheaper solution than the mechanical holders that are otherwise usual.

#### SUMMARY OF THE INVENTION

35 A method of manufacturing a coil and attaching the manufactured coil to the contact points of an electric circuit, wherein one end of a winding filament is brought in a stretched state to a

predetermined first position in a winding machine; wherein the winding filament is wound to form a coil in the winding machine while maintaining said filament end at said first position inwardly of the coil; wherein the end of the winding filament after the coil is brought in a stretched state to a predetermined second position in the winding machine, also inwardly of the coil, and the filament then cut; wherein a circuit fixture or jig coacting with the winding machine and having an electric circuit inlaid in a predetermined third position that corresponds to said first and said second positions in the winding machine is brought into contact with the winding machine to collect the wound coil; and wherein the filament ends of the coil are finally welded together with the contact points on the electric circuit located inwardly of the coil.

These and other characteristic features of the inventive method and the inventive apparatus for carrying out the method will be evident from the following Claims.

#### DETAILED DESCRIPTION OF THE INVENTION

##### Apparatus Description

The invention will now be described in more detail with reference to the accompanying drawing which illustrates schematically apparatus for carrying out the inventive method.

The apparatus includes a winding machine 1 and a circuit fixture or jig 2 which coacts with the winding machine.

The winding machine 1 includes a rotatable bobbin plate 11 which has in the centre thereof a hole 110 for firmly holding filament ends by means of subpressure, and also has a slightly raised centre part 115 (about 0.15-0.35 mm). Provided on the periphery of this centre part, to the left in the drawing, are a first pin 113 and a second pin 114 which lie relatively close

to one another and which are intended as supports for the filament ends. The machine also includes a movably arranged bobbin lid 12 which can be moved towards and away from the bobbin plate 11 and which has holes (not shown) corresponding to the pins 113, 114, a filament guide means 13 for guiding the filament 30 during winding of a coil, and filament guide means 14 for locking the outer filament end of a wound coil to the bobbin plate 11, whereas the filament guiding member 13 guides the filament transversely across the centre hole 110 to a filament holder 15 having filament cutting means 151. The bobbin plate 11 has a first position 111 and a second position 112 to which one end of the winding filament is brought in a stretched state prior to winding the coil, and to which the terminal end of the coil is brought in a stretched state subsequent to winding the coil. A small recess (groove) is provided in the plate at said two positions, between the periphery and the centre, for receiving respective filament ends.

The circuit fixture or jig 2 has a bottom plate 21 which corresponds to the bobbin plate 11 and which has a hole 210 in the centre of the plate for firmly holding filament ends with the aid of subpressure, corresponding to the hole 110 in the bobbin plate, and also has a pre-selected third position 231 for firmly holding electric circuit 3 with the contact points 31, 32, said third position corresponding to said first and said second positions on the bobbin plate 11. The plate has a slightly raised centre part 215, in whose periphery there is provided a third pin 213 and a fourth pin 214 which are seated relatively close together and placed so as to take over the function of the pins 113, 114 as filament end support means. The positions of these filament ends will herewith be changed slightly, although not sufficient to risk the filament ends releasing their direct contact with the contact points of the electric circuit. The bottom plate 21 is mounted on a rotatable arm 22, which rotates about an axis 23. The arm can be rotated through 180° in relation to the bottom plate 11, such as to

collect a finished coil (with subpressure). The ends of the coil will herewith automatically be brought into abutment with the contact points on the electric circuit, so that the coil ends and contact points can be welded together.

#### Method Description

1. The bobbin lid 12 is open and the filament 30 is stretched over the hole 110 through the medium of the first pin 113, and is held by the filament holder 15.

2. The filament holder 15 is opened and the filament end is drawn down into the hole 110 by suction and the bobbin lid 12 closed.

3. Coil winding is commenced with the filament end fixed in the hole 110 and stretched over said first position 111.

4. Subsequent to having wound the coil, the bobbin lid 12 is opened and the filament guide 14 enters and locks the filament end firmly in the outer turns of the coil.

5. The filament guide 13 moves to the filament holder 15 with the filament which is herewith stretched over the hole 110 through the medium of the second pin 114, whereafter the filament cutting means 151 cuts off the filament, which is then sucked down into the hole 110.

6. The filament guide 14 moves to one side and the coil is ready.

7. The circuit fixture or jig 2 with the inlaid electric circuit 3 is rotated counter clockwise through 180° and collects the finished coil, wherein filament fixation is effected by means of subpressure in the hole 210. The coil and the electric circuit are also fixated with the aid of subpressure.

8. The circuit fixture 2 with electric circuit 3 and coil is turned back (clockwise) to the starting position, whereupon the filament ends of the coil and the contact points of the electric circuit are welded together.

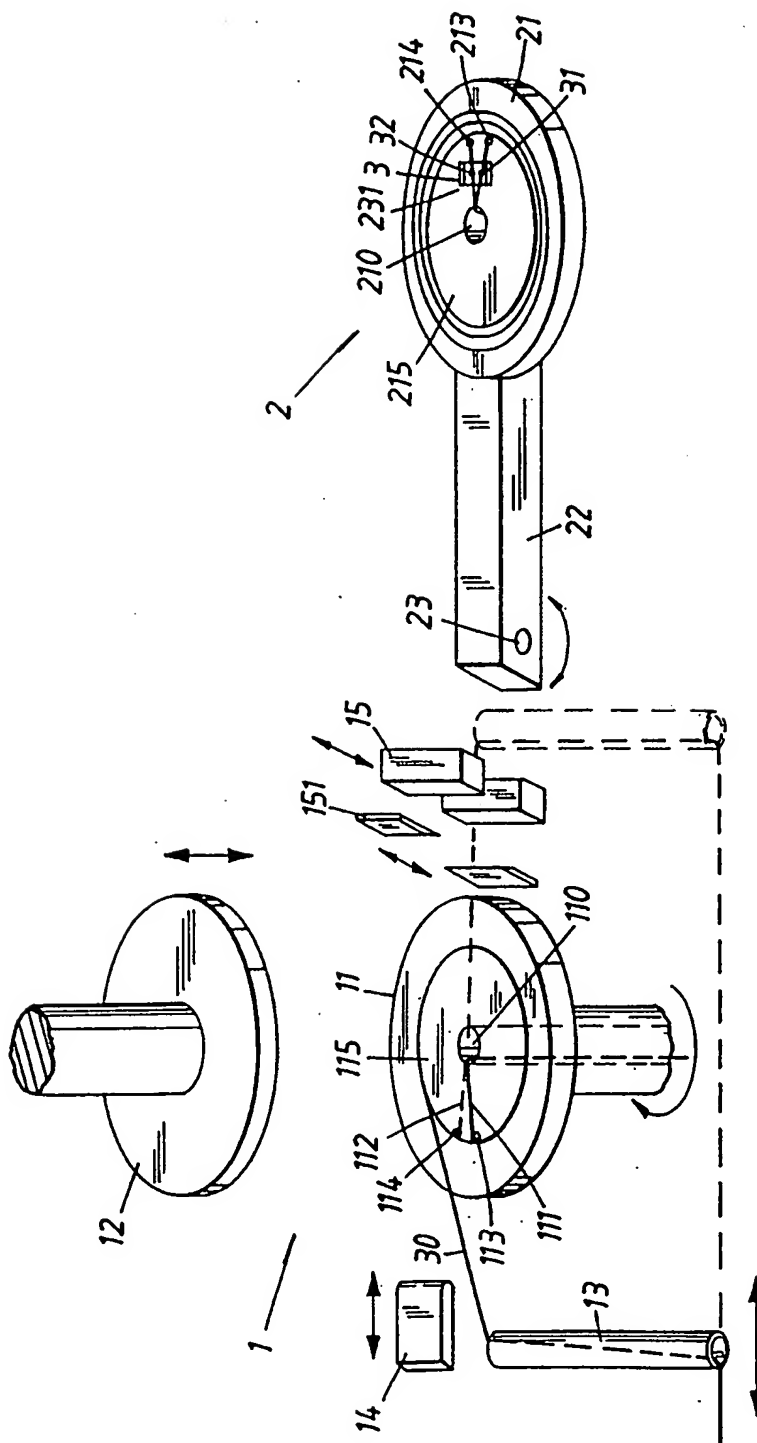
## CLAIMS

1. A method of manufacturing a coil and attaching the coil to the contact points of an electric circuit, wherein one end of a winding filament (30) is brought in a stretched state to a predetermined first position (111) in a winding machine (1); a coil is wound from the winding filament (30) in the winding machine (1) while keeping the filament end at said first position (111); and wherein the winding filament (30) immediately after the coil is brought in a stretched state to a predetermined second position (112) close to but completely separate from the first position (111) in the winding machine (1), whereafter the filament (30) is cut-off, characterized in that the predetermined first position (111) and the predetermined second position (112) are placed inwardly of the coil; in that a circuit fixture (2), or jig, coacting with the winding machine (1) and having an electric circuit (3) positioned at a predetermined third position (231) corresponding to the first position (111) and the second position (112) in the winding machine (1) inwardly of the coil is brought into contact with the winding machine for collecting the finished coil, wherein the filament ends of the coil nearest the coil are maintained in generally the same positions relative to the remainder of the coil; and in that the filament ends of the coil that now lie against the contact points (31, 32) on the electric circuit (3) inwardly of the coil are welded together with said contact points (31, 32).

2. A method according to Claim 1, characterized in that the ends of the winding filament (30) are held firmly in a stretched state at the first position (111) and the second position (112) at the beginning and the end of the coil respectively with the aid of subpressure in a hole (110) in the winding machine in the centre of the coil, and at the third position (231) by subpressure in a hole (210) in the fixture or jig at the centre of the coil.

3. Apparatus for carrying out the method according to Claim 1 or 2, characterized in that the apparatus includes a winding machine (1) and a movable fixture or jig (2) that coacts with the winding machine, wherein the winding machine has a rotatable bobbin plate (11) that includes in the centre of the plate a hole (110) for holding filament ends firmly through the medium of subpressure, a movable bobbin lid (12) which can be moved towards and away from the bobbin plate, a filament guide (13) for guiding filament while winding a coil and terminating the winding process, and a filament guide means (14) for locking the outer filament end of the wound coil to the bobbin plate (11) while the filament guide (13) moves the filament transversely across the centre hole (2) to a filament holder (15) having filament cutting means (151), and wherein the circuit fixture (2) has a bottom plate (21) corresponding to the bobbin plate (11) and including a hole (210) in the centre of the plate for holding firmly filament ends through the medium of subpressure, corresponding to the hole (110) in the bobbin plate, and having a pre-chosen third position (231) for holding an electric circuit (3) with contact points when the fixture is rotated to collect a wound coil from the winding machine (1) and when the filament ends of the coil are welded together with the contact points on the electric circuit.

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 96/01447

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01F 41/06

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages     | Relevant to claim No. |
|-----------|--|-----------------------|
| A         | WO 9309551 A1 (STOWASSER, HERBERT), 13 May 1993<br>(13.05.93)                          | 1,3                   |
|           | ---  |                       |
| A         | NL 8503166 A (N.V. NEDERLANDSCHE APPARATENFABRIEK<br>'NEDAP'), 16 June 1987 (16.06.87) | 1,3                   |
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/SE 96/01447

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|---|---------------------|--------------------------------|----------------------|
| WO 9309551 A1                             | 13/05/93            | DE 4136718 A<br>DE 4220194 A,C | 13/05/93<br>23/12/93 |
| NL 8503166 A                              | 16/06/87            | NONE                           |                      |

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